



Appendix B

Additional Monitoring Results for 2000

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This appendix contains additional information on 2000 monitoring results, supplementing the data

summarized in the main body of the report. More detailed information is available in PNNL-13487, APP. 1.

Table B.1. Radionuclide Concentrations in Columbia River Water at Priest Rapids Dam, 2000 Compared to Previous 5 Years

Radionuclide ^(a)	No. of Samples	2000		1995-1999			Ambient Surface Water Quality Standard, pCi/L	
		Maximum	Average	No. of Samples	Maximum	Average		
Composite System								
Tritium	11	53 ± 6.9	35 ± 5.6	57 ^(c)	62 ± 12	33 ± 2.1	20,000 ^(d)	
Alpha (gross)	12	1.2 ± 1.0	0.63 ± 0.22	60	5.6 ± 3.1	0.50 ± 0.19	15 ^(e,f)	
Beta (gross)	12	3.5 ± 1.7	1.1 ± 0.69	60	7.7 ± 2.2	0.98 ± 0.44	50 ^(e,f)	
Strontium-90	12	0.082 ± 0.034	0.072 ± 0.0051	60	0.13 ± 0.062	0.079 ± 0.0050	8 ^(e,f)	
Technetium-99	12	0.16 ± 0.28	-0.019 ± 0.0072	60	1.6 ± 0.69	0.022 ± 0.066	900 ^(d)	
Iodine-129 ^(h)	4	0.000014 ± 0.0000012	0.0000082 ± 0.0000050	16	0.000022 ± 0.0000021	0.000010 ± 0.0000033	1 ^(d)	
Uranium-234	12	0.26 ± 0.060	0.22 ± 0.013	60	0.42 ± 0.087	0.24 ± 0.013	-- ^(g)	
Uranium-235	12	0.0079 ± 0.013	0.0027 ± 0.0017	60	0.029 ± 0.016	0.0079 ± 0.0018	--	
Uranium-238	12	0.19 ± 0.058	0.17 ± 0.0098	60	0.38 ± 0.080	0.20 ± 0.012	--	
Uranium (total)	12	0.44 ± 0.11	0.40 ± 0.016	60	0.81 ± 0.18	0.45 ± 0.025	--	
Continuous System								
Cobalt-60 ⁽ⁱ⁾	P	12	0.00088 ± 0.00069	0.00026 ± 0.00022	36	0.0015 ± 0.00097	0.00018 ± 0.00019	100 ^(d)
	D	12	0.0016 ± 0.0022	-0.000064 ± 0.00074	36	0.0065 ± 0.0057	0.00042 ± 0.00099	
Cesium-137 ⁽ⁱ⁾	P	12	0.0012 ± 0.00072	0.00044 ± 0.00025	36	0.0031 ± 0.0016	0.0011 ± 0.00027	200 ^(d)
	D	12	0.0030 ± 0.0019	0.0011 ± 0.00061	36	0.24 ± 0.0016	0.0072 ± 0.013	
Europium-155 ⁽ⁱ⁾	P	12	0.0012 ± 0.0017	0.000070 ± 0.00044	36	0.0032 ± 0.0044	0.00051 ± 0.00037	600 ^(d)
	D	12	0.0060 ± 0.0056	0.00087 ± 0.0016	36	0.012 ± 0.014	0.0019 ± 0.0015	
Plutonium-239/240	P	4	0.000026 ± 0.000011	0.000020 ± 0.0000067	20	0.00028 ± 0.00010	0.000052 ± 0.000028	--
	D	4	0.000048 ± 0.000079	0.000023 ± 0.000022	20	0.000072 ± 0.000082	0.000018 ± 0.000010	

- (a) Radionuclides measured using the continuous system show the particulate (P) and dissolved (D) fractions separately. Other radionuclides are based on unfiltered samples collected by the composite system (see Section 4.2).
- (b) Maximum values are ± total propagated analytical uncertainty (2 sigma). Averages are ±2 standard error of the calculated mean.
- (c) Excludes one result of 200 ± 22 pCi/L.
- (d) WAC 173-201A-050 and EPA-570/9-76-003.
- (e) WAC 246-290.
- (f) 40 CFR 141.
- (g) Dashes indicate no concentration guides available.
- (h) From 1994 through 1995, iodine-129 activities were obtained from the dissolved fraction of the continuous system. Table shows composite system results for 1996 through 2000.
- (i) All 2000 results were less than the detection limit.

Table B.2. Radionuclide Concentrations in Columbia River Water at the Richland Pumphouse, 2000 Compared to Previous 5 Years

Radionuclide ^(a)	No. of Samples	2000		1995-1999			Ambient Surface Water Quality Standard, pCi/L	
		Maximum	Average	No. of Samples	Maximum	Average		
Composite System								
Tritium	11	98 ± 11	77 ± 11	58	150 ± 11	70 ± 6.8	20,000 ^(c)	
Alpha (gross)	12	1.5 ± 1.1	0.60 ± 0.23	60	2.2 ± 1.1	0.55 ± 0.11	15 ^(c,d)	
Beta (gross)	12	2.3 ± 1.6	0.76 ± 0.41	60	6.6 ± 2.5	0.98 ± 0.38	50 ^(c,d)	
Strontium-90	12	0.10 ± 0.037	0.065 ± 0.0085	60	0.30 ± 0.081	0.083 ± 0.0091	8 ^(c,d)	
Technetium-99	12	0.30 ± 0.26	0.0034 ± 0.066	60	0.53 ± 0.52	0.034 ± 0.042	900 ^(e)	
Iodine-129 ^(g)	4	0.00012 ± 0.0000057	0.000090 ± 0.000026	16	0.00016 ± 0.000013	0.00011 ± 0.000023	1 ^(e)	
Uranium-234	12	0.33 ± 0.078	0.25 ± 0.023	60	0.45 ± 0.081	0.27 ± 0.016	-- ^(f)	
Uranium-235	12	0.014 ± 0.013	0.0062 ± 0.0032	60	0.048 ± 0.022	0.0096 ± 0.0021	--	
Uranium-238	12	0.23 ± 0.054	0.19 ± 0.014	60	0.30 ± 0.060	0.22 ± 0.010	--	
Uranium (total)	12	0.56 ± 0.15	0.45 ± 0.034	60	0.78 ± 0.16	0.50 ± 0.024	--	
Continuous System								
Cobalt-60 ^(h)	P	12	0.00088 ± 0.00071	0.00028 ± 0.00021	27	0.0016 ± 0.0011	0.000063 ± 0.000026	100 ^(e)
	D	12	0.0022 ± 0.0021	0.00056 ± 0.00049	27	0.0062 ± 0.0054	0.0010 ± 0.00085	
Cesium-137 ^(h)	P	12	0.0012 ± 0.00074	0.00049 ± 0.00023	27	0.0037 ± 0.0015	0.0014 ± 0.00034	200 ^(e)
	D	12	0.0023 ± 0.0014	0.00092 ± 0.00051	27	0.0071 ± 0.0052	0.0015 ± 0.00072	
Europium-155 ^(h)	P	12	0.0022 ± 0.0017	0.00060 ± 0.00055	27	0.0029 ± 0.017	0.00022 ± 0.00054	600 ^(e)
	D	12	0.0056 ± 0.0039	0.0014 ± 0.0012	27	0.0093 ± 0.012	0.0010 ± 0.0018	
Plutonium-239/240	P	4	0.000028 ± 0.000013	0.000014 ± 0.000011	17	0.00017 ± 0.000083	0.000051 ± 0.000022	--
	D	4	0.000063 ± 0.000090	0.000032 ± 0.000028	17	0.00016 ± 0.000091	0.000038 ± 0.000020	

- (a) Radionuclides measured using the continuous system show the particulate (P) and dissolved (D) fractions separately. Other radionuclides are based on unfiltered samples collected by the composite system (see Section 4.2).
- (b) Maximum values are ± total propagated analytical uncertainty (2 sigma). Averages are ±2 standard error of the calculated mean.
- (c) 40 CFR 141.
- (d) WAC 246-290.
- (e) WAC 173-201A-050 and EPA-570/9-76-003.
- (f) Dashes indicate no concentration guides available.
- (g) From 1994 through 1995, iodine-129 activities were obtained from the dissolved fraction of the continuous system. Table shows composite system results for 1996 through 2000.
- (h) All 2000 results were less than the detection limit.



Table B.3. Radionuclide Concentrations Measured in Columbia River Water along Transects of the Hanford Reach, 2000

Transect/Radionuclide	No. of Samples	Concentration,^(a) pCi/L		
		Maximum	Minimum	Mean
Vernita Bridge (HRM 0.3)^(b)				
Tritium	16	46 ± 6.3	27 ± 4.8	35 ± 3.2
Strontium-90	16	0.085 ± 0.034	0.043 ± 0.025	0.067 ± 0.0056
Uranium (total)	16	0.51 ± 0.13	0.34 ± 0.12	0.38 ± 0.023
100-N Area (HRM 9.5)				
Tritium	9	150 ± 16	26 ± 4.8	56 ± 28
Strontium-90	7	0.17 ± 0.051	0.058 ± 0.031	0.087 ± 0.029
Uranium (total)	7	0.42 ± 0.13	0.32 ± 0.086	0.36 ± 0.032
100-F Area (HRM 19)				
Tritium	7	33 ± 6.3	24 ± 4.7	29 ± 2.3
Strontium-90	6	0.076 ± 0.037	0.062 ± 0.034	0.069 ± 0.0045
Uranium (total)	6	0.45 ± 0.12	0.31 ± 0.10	0.37 ± 0.041
Old Hanford Townsite (HRM 28.7)				
Tritium	8	500 ± 45	27 ± 5.8	150 ± 130
Strontium-90	6	0.081 ± 0.039	0.046 ± 0.024	0.060 ± 0.010
Uranium (total)	6	0.39 ± 0.11	0.34 ± 0.099	0.36 ± 0.012
300 Area (HRM 43.1)				
Tritium	8	58 ± 8.1	29 ± 6.0	41 ± 7.8
Strontium-90	6	0.074 ± 0.033	0.050 ± 0.032	0.062 ± 0.0072
Uranium (total)	6	0.54 ± 0.14	0.34 ± 0.097	0.41 ± 0.059
Richland Pumphouse (HRM 46.4)				
Tritium	28	150 ± 14	23 ± 5.8	59 ± 14
Strontium-90	26	0.13 ± 0.045	0.046 ± 0.029	0.067 ± 0.0074
Uranium (total)	26	0.94 ± 0.19	0.32 ± 0.088	0.45 ± 0.055

(a) Maximum and minimum values are ± total propagated analytical uncertainty (2 sigma). Mean values are ±2 standard error of the mean.

(b) HRM = Hanford River Mile (e.g., Vernita Bridge crossing is Mile 0, the Richland Pumphouse is Mile 46.4).

Table B.4. Radionuclide Concentrations Measured in Columbia River Water at Nearshore Locations in the Hanford Reach, 2000

Nearshore/Radionuclide	No. of Samples	Concentration, ^(a) pCi/L		
		Maximum	Minimum	Mean
Vernita Bridge (HRM 0.3)^(b)				
Tritium	4	41 ± 5.8	27 ± 6.0	34 ± 6.1
Strontium-90	4	0.079 ± 0.041	0.072 ± 0.034	0.076 ± 0.0033
Uranium (total)	4	0.40 ± 0.12	0.35 ± 0.089	0.38 ± 0.023
100-N Area (HRM 8.4 to 9.8)				
Tritium	11	150 ± 16	31 ± 5.2	60 ± 21
Strontium-90	6	0.27 ± 0.076	0.068 ± 0.031	0.12 ± 0.062
Uranium (total)	6	0.42 ± 0.11	0.33 ± 0.086	0.36 ± 0.026
100-F Area (HRM 18-23)				
Tritium	6	34 ± 6.2	30 ± 5.1	32 ± 1.3
Strontium-90	4	0.080 ± 0.036	0.050 ± 0.013	0.069 ± 0.013
Uranium (total)	4	0.40 ± 0.12	0.33 ± 0.096	0.37 ± 0.031
Old Hanford Townsite (HRM 26 to 30)				
Tritium	9	4,100 ± 360	24 ± 5.8	810 ± 920
Strontium-90	5	0.081 ± 0.039	0.046 ± 0.026	0.062 ± 0.012
Uranium (total)	5	0.43 ± 0.12	0.30 ± 0.091	0.35 ± 0.044
300 Area (HRM 41.5 to 43.1)				
Tritium	10	580 ± 52	37 ± 6.7	180 ± 130
Strontium-90	5	0.072 ± 0.033	0.048 ± 0.026	0.059 ± 0.0084
Uranium (total)	5	0.58 ± 0.13	0.18 ± 0.061	0.40 ± 0.13
Richland Pumphouse (HRM 43.5 to 46.4)				
Tritium	26	87 ± 8.2	33 ± 6.5	50 ± 6.8
Strontium-90	22	0.095 ± 0.043	0.042 ± 0.024	0.069 ± 0.0068
Uranium (total)	22	0.66 ± 0.16	0.20 ± 0.066	0.41 ± 0.065

(a) Maximum and minimum values are ± total propagated analytical uncertainty (2 sigma). Mean values are ±2 standard error of the mean.

(b) HRM = Hanford River Mile (e.g., Vernita Bridge crossing is Mile 0, the Richland Pumphouse is Mile 46.4).



Table B.5. Selected U.S. Geological Survey Columbia River Water Quality Data,^(a) 2000

Analysis	Units	Vernita Bridge (upstream)				Richland Pumphouse (downstream)				Washington Ambient Surface Water Quality Standard^(b)
		No. of Samples	Median	Maximum	Minimum	No. of Samples	Median	Maximum	Minimum	
Temperature	°C	9	11	19	4.5	3	17	18	4.7	20 (maximum)
Dissolved oxygen	mg/L	9	12	14	9.2	3	11	13	8.8	8 (minimum)
Turbidity	NTU ^(c)	9	0.70	3.0	<0.1	3	0.70	0.80	0.50	5 + background
pH	pH units	9	8.0	8.2	7.9	3	8.1	8.2	8.0	6.5 - 8.5
Sulfate, dissolved	mg/L	9	7.7	9.3	6.1	3	8.1	10	6.7	-- ^(d)
Dissolved solids, 180°C (356°F)	mg/L	9	78	85	67	3	81	90	68	--
Specific conductance	µS/cm	9	140	151	115	3	132	152	116	--
Total hardness, as CaCO ₃	mg/L	1	61	61	61	3	56	64	50	--
Alkalinity	mg/L	9	57	62	46	3	52	60	42	--
Phosphorus, total	mg/L	9	0.006	0.05	0.005	3	<0.05	<0.05	<0.05	--
Chromium, dissolved	µg/L	1	<0.8	<0.8	<0.8	4	<0.8	<0.8	0.5	--
Dissolved organic carbon	mg/L	9	1.5	1.9	1.1	3	1.8	7.8	1.1	--
Iron, dissolved	µg/L	9	<10	<10	6	3	<10	<10	<10	--
Ammonia, dissolved, as N	mg/L	9	<0.04	0.002	<0.002	3	<0.02	<0.02	<0.02	--
Nitrite + nitrate, dissolved, as N	mg/L	9	0.12	0.22	0.04	3	0.10	0.15	0.070	--

(a) Provisional data from U.S. Geological Survey National Stream Quality Accounting Network (NASQAN), subject to revision.

(b) From WAC 173-201A.

(c) NTU = Nephelometric turbidity units.

(d) Dashes indicate no standard available.

Table B.6. Concentrations ($\mu\text{g/L}$) of Dissolved Metals in Columbia River Transect and Nearshore Water Samples, 2000

Location	Metal	No. of Samples	Maximum	Minimum	Average	$\pm 2\text{SEM}^{(a)}$
Vernita Bridge	Antimony	20	0.20	0.17	0.18	0.0045
	Arsenic	20	0.63	0.43	0.53	0.0250
	Beryllium	20	0.048	0.012	0.021	0.0072
	Cadmium	20	0.027	0.014	0.018	0.0019
	Chromium	20	0.27	0.042	0.19	0.039
	Copper	20	0.72	0.50	0.58	0.037
	Lead	20	0.062	0.0035	0.015	0.0062
	Mercury	5	0.00064	0.00026	0.00044	0.00015
	Nickel	20	0.57	0.14	0.30	0.067
	Selenium	20	0.39	0.096	0.25	0.053
	Silver	20	0.050	0.00083	0.017	0.0094
	Thallium	20	0.038	0.020	0.029	0.0030
	Zinc	20	2.8	1.0	1.8	0.29
100-N Area	Antimony	10	0.21	0.17	0.19	0.0082
	Arsenic	10	0.58	0.44	0.51	0.023
	Beryllium	10	0.048	0.048	0.048	0
	Cadmium	10	0.058	0.015	0.029	0.0076
	Chromium	10	1.1	0.042	0.24	0.21
	Copper	10	0.56	0.36	0.44	0.041
	Lead	10	0.029	0.0023	0.012	0.0056
	Mercury	0				
	Nickel	10	0.54	0.38	0.44	0.035
	Selenium	10	0.39	0.39	0.39	0
	Silver	10	0.050	0.0043	0.014	0.012
	Thallium	10	0.027	0.023	0.025	0.00095
	Zinc	10	1.0	0.67	0.77	0.088
100-F Area	Antimony	10	0.20	0.15	0.18	0.0088
	Arsenic	10	0.60	0.45	0.55	0.028
	Beryllium	10	0.48	0.48	0.48	0
	Cadmium	10	0.045	0.015	0.020	0.0062
	Chromium	10	0.21	0.042	0.066	0.033
	Copper	10	0.50	0.40	0.45	0.020
	Lead	10	0.027	0.0046	0.011	0.0044
	Mercury	0				
	Nickel	10	0.48	0.36	0.42	0.024
	Selenium	10	0.39	0.39	0.39	0
	Silver	10	0.0096	0.0043	0.0061	0.0013
	Thallium	10	0.030	0.022	0.026	0.0015
	Zinc	10	1.7	0.54	0.92	0.23
Old Hanford Townsite	Antimony	10	0.20	0.17	0.18	0.0063
	Arsenic	10	0.74	0.46	0.55	0.048
	Beryllium	10	0.048	0.048	0.048	0
	Cadmium	10	0.031	0.015	0.021	0.0037
	Chromium	10	0.73	0.061	0.38	0.16
	Copper	10	0.49	0.41	0.45	0.014
	Lead	10	0.020	0.0049	0.0098	0.0028
	Mercury	0				
	Nickel	10	0.47	0.39	0.44	0.016
	Selenium	10	0.39	0.39	0.39	0
	Silver	10	0.012	0.0043	0.0063	0.0016
	Thallium	10	0.030	0.023	0.026	0.0014
	Zinc	10	0.90	0.58	0.77	0.063



Table B.6. (contd)

Location	Metal	No. of Samples	Maximum	Minimum	Average	$\pm 2SEM^{(a)}$
300 Area	Antimony	10	0.20	0.17	0.18	0.0070
	Arsenic	10	0.77	0.49	0.59	0.070
	Beryllium	10	0.048	0.048	0.048	0
	Cadmium	10	0.038	0.015	0.020	0.0048
	Chromium	10	0.74	0.042	0.12	0.14
	Copper	10	0.60	0.44	0.47	0.029
	Lead	10	0.031	0.0099	0.017	0.0039
	Mercury	0				
	Nickel	10	0.47	0.38	0.42	0.016
	Selenium	10	0.39	0.39	0.39	0
	Silver	10	0.0064	0.0043	0.0048	0.00054
	Thallium	10	0.029	0.024	0.027	0.0011
Richland Pumphouse	Zinc	10	5.4	0.63	1.4	0.92
	Antimony	41	0.26	0.16	0.19	0.0053
	Arsenic	41	0.81	0.44	0.54	0.026
	Beryllium	41	0.048	0.012	0.020	0.0050
	Cadmium	41	0.046	0.011	0.022	0.0029
	Chromium	41	0.88	0.15	0.27	0.042
	Copper	41	0.74	0.39	0.55	0.037
	Lead	41	0.018	0.0011	0.0096	0.0013
	Mercury	11	0.0010	0.00036	0.00059	0.00014
	Nickel	41	0.42	0.077	0.26	0.031
	Selenium	41	0.44	0.064	0.25	0.037
	Silver	41	0.011	0.00095	0.0043	0.00059
	Thallium	41	0.037	0.020	0.028	0.0019
	Zinc	41	6.6	0.45	1.8	0.37

SEM = Standard error of the mean.

**Table B.7. Radionuclide Concentrations in Sediment from the Columbia River and from Columbia River Riverbank Springs, 2000
Compared to Previous 5 Years**

<u>Location</u>	<u>Radionuclide</u>	<u>No. of Samples</u>	2000		<u>No. of Samples</u>	1995-1999	
			<u>Concentration, pCi/g</u>	<u>Median^(a)</u>		<u>Concentration, pCi/g</u>	<u>Median^(a)</u>
River Sediment							
100-F Slough	Cobalt-60	1		0.016 ± 0.011	5	0.024	0.033 ± 0.011
	Cesium-137	1		0.32 ± 0.040	5	0.36	0.49 ± 0.054
	Europium-155	1		0.025 ± 0.026	5	0.033	0.061 ± 0.033
	Plutonium-239/240	1		0.0023 ± 0.00054	5	0.0020	0.0024 ± 0.00082
	Strontium-90	1		-0.0095 ± 0.020	5	0.0032	0.0062 ± 0.0047
	Uranium-235	1		0.011 ± 0.0068	5	0.0022	0.064 ± 0.068
	Uranium-238	1		0.29 ± 0.058	5	0.15	1.4 ± 0.41
Hanford Slough	Cobalt-60	1		-0.0092 ± 0.011	5	0.18	0.32 ± 0.046
	Cesium-137	1		0.011 ± 0.012	5	0.25	0.59 ± 0.068
	Europium-155	1		0.058 ± 0.030	5	0.068	0.083 ± 0.045
	Plutonium-239/240	1		0.00064 ± 0.00023	5	0.0037	0.0076 ± 0.0014
	Strontium-90	1		0.00015 ± 0.024	5	0.0059	0.016 ± 0.0090
	Uranium-235	1		0.012 ± 0.0070	5	0.040	0.24 ± 0.16
	Uranium-238	1		0.34 ± 0.067	5	1.4	2.4 ± 0.88
McNary Dam	Cobalt-60	2	0.017	0.030 ± 0.036	24	0.048	0.17 ± 0.032
	Cesium-137	2	0.36	0.45 ± 0.079	24	0.39	1.0 ± 0.11
	Europium-155	2	0.047	0.085 ± 0.080	24	0.054	0.091 ± 0.042
	Plutonium-239/240	2	0.0089	0.011 ± 0.0020	24	0.0080	0.014 ± 0.0026
	Strontium-90	2	0.021	0.029 ± 0.030	24	0.023	0.048 ± 0.011
	Uranium-235	2	0.020	0.022 ± 0.013	24	0.027	0.21 ± 0.10
	Uranium-238	2	0.64	0.67 ± 0.13	24	0.82	2.3 ± 0.71
Priest Rapids Dam	Cobalt-60	2	0.0075	0.0082 ± 0.016	23	0.0018	0.042 ± 0.041
	Cesium-137	2	0.39	0.44 ± 0.056	23	0.34	0.67 ± 0.077
	Europium-155	2	0.058	0.064 ± 0.039	23	0.049	0.10 ± 0.050
	Plutonium-239/240	2	0.0087	0.0096 ± 0.0017	23	0.0078	0.017 ± 0.0030
	Strontium-90	2	0.019	0.028 ± 0.028	23	0.013	0.019 ± 0.0058
	Uranium-235	2	0.68	0.73 ± 0.13	23	0.022	0.32 ± 0.17
	Uranium-238	2	0.61	0.65 ± 0.12	23	0.71	2.2 ± 0.71

Table B.7. (contd)

Location	Radionuclide	2000		1995-1999	
		No. of Samples	Concentration, pCi/g	No. of Samples	Concentration, pCi/g
Richland	Cobalt-60	1	-0.052 ± 0.19	5	0.035
	Cesium-137	1	0.23 ± 0.051	5	0.24
	Europium-155	1	0.047 ± 0.059	5	0.030
	Plutonium-239/240	1	0.0011 ± 0.00050	5	0.0021
	Strontium-90	1	0.00065 ± 0.020	5	0.0043
	Uranium-235	1	0.0096 ± 0.0093	5	0.014
	Uranium-238	1	0.24 ± 0.053	5	0.83
White Bluffs Slough	Cobalt-60	1	0.061 ± 0.023	5	0.11
	Cesium-137	1	0.53 ± 0.061	5	0.53
	Europium-155	1	0.0065 ± 0.039	5	0.052
	Plutonium-239/240	1	0.0058 ± 0.0011	5	0.0039
	Strontium-90	1	-0.0041 ± 0.023	5	0.0052
	Uranium-235	1	0.027 ± 0.010	5	0.0087
	Uranium-238	1	0.59 ± 0.11	5	1.0
Riverbank Spring Sediment					
100-B Spring	Cobalt-60	1	0.00088 ± 0.010	5	0.021
	Cesium-137	1	0.063 ± 0.019	5	0.095
	Europium-155	1	0.077 ± 0.031	5	0.065
	Strontium-90	1	0.0020 ± 0.024	5	0.0027
	Uranium-235	1	0.0053 ± 0.0045	5	0.029
	Uranium-238	1	0.21 ± 0.044	5	1.1
100-F Spring	Cobalt-60	1	0.021 ± 0.032	5	0.018
	Cesium-137	1	0.092 ± 0.045	5	0.19
	Europium-155	1	0.042 ± 0.079	5	0.030
	Strontium-90	1	0.013 ± 0.032	5	0.0043
	Uranium-235	1	0.016 ± 0.0082	6	0.067
	Uranium-238	1	0.35 ± 0.065	6	0.83

Table B.7. (contd)

Location	Radionuclide	1999			1994-1998		
		No. of Samples	Concentration, pCi/g		No. of Samples	Concentration, pCi/g	
			Median^(a)	Maximum^(b)		Median^(a)	Maximum^(b)
100-K Spring	Cobalt-60	(c)			2	0.011	0.015 ± 0.021
	Cesium-137	(c)			2	0.17	0.19 ± 0.046
	Europium-155	(c)			2	0.084	0.13 ± 0.066
	Strontium-90	(c)			2	0.0049	0.0085 ± 0.0048
	Uranium-235	(c)			2	0.17	0.20 ± 0.14
	Uranium-238	(c)			2	1.2	1.5 ± 0.54
300 Area Spring	Cobalt-60	2	0.011	0.013 ± 0.012	5	0.013	0.020 ± 0.010
	Cesium-137	2	0.16	0.27 ± 0.035	5	0.077	0.21 ± 0.029
	Europium-155	2	0.033	0.037 ± 0.037	5	0.045	0.086 ± 0.035
	Uranium-235	2			5	0.18	0.41 ± 0.16
	Uranium-238	2			5	2.2	5.2 ± 1.1
Hanford Spring	Cobalt-60	2	0.051	0.062 ± 0.017	5	0.059	0.086 ± 0.015
	Cesium-137	2	0.20	0.22 ± 0.031	5	0.23	0.29 ± 0.032
	Europium-155	2	0.073	0.10 ± 0.053	5	0.066	0.069 ± 0.035

(a) Median values are not provided when only one sample analyzed.

(b) Values are ± total propagated analytical uncertainty (2 sigma).

(c) Sediment was not available at the 2000 spring location.



Table B.8. Median Metal Concentrations (mg/kg dry wt.) in Columbia River Sediment, 2000

<u>Metal</u>	(n=2) <u>Priest Rapids Dam</u>	(n=4) <u>Hanford Reach^(a)</u>	(n=2) <u>McNary Dam</u>	(n=6) <u>Riverbank Springs^(b)</u>
Antimony	1.0	0.62	0.87	0.54
Arsenic	7.8	4.6	7.0	5.6
Beryllium	1.5	1.5	1.5	1.5
Cadmium	6.3	0.79	3.4	0.64
Chromium	82	54	57	74
Copper	57	22	35	16
Lead	44	30	27	23
Mercury	0.16	0.0028	0.11	0.014
Nickel	48	20	28	20
Selenium	0.59	0.40	0.46	0.26
Silver	0.47	0.27	0.37	0.31
Thallium	1.4	0.61	0.84	0.49
Zinc	570	260	360	150

(a) 100-F Slough, Hanford Slough, White Bluffs Slough, and Richland.

(b) 100-B Area, 100-F Area, Old Hanford Townsite, and 300 Area.

Table B.9. Radionuclide Concentrations Measured in Water from Riverbank Springs, 2000 Compared to Previous 5 Years

<u>Location/Radionuclide</u>	2000			1995-1999			<u>Washington State Ambient Surface Water Quality Standard,^(b) pCi/L</u>	
	<u>No. of Samples</u>	<u>Concentration,^(a) pCi/L</u>	<u>Maximum</u>	<u>Median</u>	<u>No. of Samples</u>	<u>Concentration,^(a) pCi/L</u>	<u>Maximum</u>	<u>Median</u>
100-B Area Springs								
Alpha (gross)	3	2.9 ± 1.8	2.5		10	2.4 ± 1.2	1.2	15
Beta (gross)	3	8.1 ± 2.1	6.0		10	28 ± 3.8	11	50
Strontium-90	3	0.093 ± 0.23	0.032		8	7.4 ± 1.6	0.030	8
Technetium-99	1	2.0 ± 0.36	2.0		4	25 ± 3.2	14	900 ^(c)
Tritium	3	7,600 ± 420	7,200		8	24,000 ± 1,800	13,000	20,000
100-D Area Springs								
Alpha (gross)	8	4.4 ± 2.3	0.97		16	3.6 ± 1.5	0.89	15
Beta (gross)	8	5.5 ± 1.8	4.2		16	14 ± 3.6	3.6	50
Strontium-90	2	1.4 ± 0.36	0.73		12	5.3 ± 1.2	0.78	8
Tritium	8	9,800 ± 730	1,100		7	5,900 ± 530	360	20,000
100-F Area Springs								
Alpha (gross)	4	5.3 ± 3.1	3.2		7	41 ± 18	6.3	15
Beta (gross)	4	13 ± 2.8	7.7		7	65 ± 11	15	50
Strontium-90	4	0.95 ± 0.32	0.085		7	0.094 ± 0.057	0.012	8
Tritium	4	960 ± 270	820		7	1,800 ± 240	1,200	20,000
Uranium (total)	1	2.5 ± 0.48	2.5		5	9.2 ± 4.3	4.6	-- ^(d)
100-H Area Springs								
Alpha (gross)	6	1.6 ± 1.0	0.94		16	10 ± 3.7	1.7	15
Beta (gross)	6	15 ± 2.1	3.5		16	85 ± 8.8	7.1	50
Strontium-90	2	5.6 ± 1.3	2.8		4	17 ± 3.1	13	8
Technetium-99	2	0.30 ± 0.26	0.18		5	140 ± 15	18	900
Tritium	6	1,200 ± 320	310		11	2,500 ± 400	840	20,000
Uranium (total)	2	0.58 ± 0.14	0.45		5	9.3 ± 3.9	1.7	--
100-K Area Springs								
Alpha (gross)	2	1.9 ± 1.4	1.1		9	4.1 ± 2.1	0.78	15
Beta (gross)	2	5.2 ± 1.9	4.2		9	21 ± 3.2	4.5	50
Strontium-90	2	2.1 ± 0.52	1.1		4	0.59 ± 0.13	0.029	8
Technetium-99	1	0.27 ± 0.26	0.27		1	-0.021 ± 0.51	-0.021	900 ^(c)
Tritium	2	5,400 ± 340	2,700		7	20,000 ± 1,500	4,400	20,000



Table B.9. (contd)

<u>Location/Radionuclide</u>	<u>2000</u>			<u>1995-1999</u>			<u>Washington State Ambient Surface Water Quality Standard,^(b) pCi/L</u>	
	<u>No. of Samples</u>	<u>Concentration,^(a) pCi/L</u>	<u>Maximum</u>	<u>Median</u>	<u>No. of Samples</u>	<u>Concentration,^(a) pCi/L</u>	<u>Maximum</u>	<u>Median</u>
100-N Area Springs								
Alpha (gross)	1	1.6 ± 1.4	1.6		6	2.8 ± 1.2	0.78	15
Beta (gross)	1	5.9 ± 2.1	5.9		6	16,000 ± 1,400	3.2	50
Strontium-90	1	-0.0026 ± 0.037	-0.0026		5	9,900 ± 1,800	0.079	8
Tritium	1	18,000 ± 800	18,000		6	24,000 ± 1,900	16,000	20,000
300 Area Springs								
Alpha (gross)	2	120 ± 29	97		6	230 ± 49	50	15
Beta (gross)	2	29 ± 5.0	28		6	49 ± 7.9	15	50
Iodine-129	2	0.0057 ± 0.00053	0.0054		6	0.0062 ± 0.00056	0.0048	1
Technetium-99	2	16 ± 2.0	14		4	14 ± 1.9	11	900 ^(c)
Tritium	2	9,900 ± 510	9,500		6	12,000 ± 940	9,900	20,000
Uranium (total)	2	130 ± 27	92		6	210 ± 99	70	--
Old Hanford Townsite Springs								
Alpha (gross)	3	3.1 ± 1.9	2.4		7	14 ± 5.9	3.2	15
Beta (gross)	3	30 ± 4.9	28		7	49 ± 7.9	22	50
Iodine-129	3	0.27 ± 0.029	0.15		7	0.41 ± 0.024	0.17	1
Technetium-99	3	80 ± 6.1	72		7	120 ± 8.0	57	900 ^(c)
Tritium	3	79,000 ± 3,100	61,000		7	120,000 ± 8,800	75,000	20,000
Uranium (total)	3	3.2 ± 0.61	2.4		7	8.6 ± 1.5	3.1	--

(a) Maximum values are ± total propagated analytical uncertainty (2 sigma).

(b) WAC 246-290, 40 CFR 141, and Appendix D, Table D.2.

(c) WAC 173-201A-050 and EPA-570/9-76-003.

(d) Dashes indicate no concentration guides available.

**Table B.10. Annual Average Dose Rates Measured on and around the Hanford Site
in Calendar Year 2000**

Location	Location Number	Annual Average (mrem/yr)^(a)	Location	Location Number	Annual Average (mrem/yr)^(a)
Onsite^(b)					
100 K Area	1	76 ± 22	Mattawa	13	75 ± 9
100 D Area	2	80 ± 15	Othello	14	74 ± 5
100 F Met Tower	3	81 ± 3	Basin City	15	77 ± 4
Hanford Townsite	4	76 ± 9	Edwin Markham School	16	75 ± 15
N of 200 E	5	92 ± 8	Leslie Groves - Richlnd	17	72 ± 21
B Pond	6	93 ± 9	Pasco	18	88 ± 7
E of 200 E	7	90 ± 4	Kennewick -Ely Street	19	77 ± 2
200ESE	8	86 ± 9	Benton City	20	82 ± 4
S of 200 E	9	94 ± 11			
200 Tel. Exchange	10	83 ± 11			
SW of B/C Cribs	11	77 ± 31			
200 W SE	12	83 ± 4			
Army Loop Camp	13	84 ± 8	Distant^(c)		
3705 Bldg. 300 Area	14	81 ± 5	Yakima	21	69 ± 6
300 Water Intake	15	79 ± 7	Toppenish	22	69 ± 5
300 Southwest Gate	16	81 ± 10	Columbia River Shoreline^(d)		
300 South Gate	17	81 ± 6	Above 100 B Area	1	80 ± 18
300 Trench	18	82 ± 9	Below 100B Ret Basin	2	96 ± 15
300 NE	19	84 ± 7	Above 1K Boat Ramp	3	83 ± 8
400 E	20	81 ± 7	Below 100N Outfall	4	111 ± 9
400 W	21	85 ± 6	Above Tip 100N Berm	5	93 ± 2
400 S	22	81 ± 11	100 N Trench Spring	6	131 ± 7
400 N	23	81 ± 9	Below 100 D Area	7	62 ± 17
US Ecology NE Corner	24	84 ± 8	100-D Island	8	77 ± 7
US Ecology SE Corner	25	91 ± 12	100 H Area	9	81 ± 14
US Ecology NW Corner	26	86 ± 6	Lo End Locke Isl	10	89 ± 8
US Ecology SW Corner	27	101 ± 13	White Bluffs Fy Lnd.	11	82 ± 11
Wye Barricade	28	83 ± 5	White Bluffs Slough	12	86 ± 14
WPPSS 1; S of WNP 2	29	86 ± 8	Below 100 F	13	76 ± 10
Perimeter^(c)			100 F Flood Plain	14	82 ± 10
Ringold Met Tower	1	92 ± 9	Hanford Slough	15	92 ± 14
W End of Fir Road	2	92 ± 8	Hanf Powerline Xing	16	93 ± 8
Dogwood Met Tower	3	91 ± 7	Hanford RR Track	17	89 ± 12
Byers Landing	4	106 ± 8	Savage Isl Slough	18	77 ± 5
Battelle Complex	5	79 ± 6	Ringold Island	19	89 ± 12
WPPSS 4; WPS Warehse	6	77 ± 7	Powerline Crossing	20	85 ± 9
Horn Rapids Substa	7	83 ± 7	S End Wooded Island	21	91 ± 8
Prosser Barricade	8	89 ± 6	Islnd Above 300 Area	22	93 ± 6
Yakima Barricade	9	96 ± 8	Island Near 300 Area	23	88 ± 13
Rattlesnake Springs	10	89 ± 7	Port of Benton-River	24	81 ± 7
Wahluke Slope	11	90 ± 6	Isl DS Bateman Isl	25	92 ± 4
S End Vernita Bridge	12	86 ± 11			

(a) ±2 standard deviation of the exposure rate.

(b) All locations are shown on Figure 4.7.1.

(c) All locations are shown on Figure 4.7.2.

(d) All locations are shown on Figure 4.7.3.



Table B.11. Geographic Composite Groupings of Air Samplers for the 2000 Hanford Site Wildfire

Geographic Composite		Air Sampling Locations^(a)
Group/Area		
1	200-East	N019, N480, N481, N498, N499, N957, N967, N968, N973
2	200-East	N158, N969, N970, N972, N976, N977, N978, N984, N985, N999
3	200-West	N161, N433, N456, N457, N964, N965, N974, N987, N994
4	200-West	N155, N165, N168, N304, N441, N442, N956, N963, N966, N975
5	300	N130, N485, N486, N489
6	100-N and 100-K	N102, N103, N105, N106, N401, N402, N403, N404, N476, N478, N479
7	100-D	N468, N469, N470, N492, N493, N512, N513, N515
8	100-H and 100-F	N494, N495, N507, N508, N509, N510, N519, N520, N521, N522

(a) See PNNL-13487, APP. 2.

Table B.12. Surface Environmental Surveillance Project Samples Collected for the 2000 Hanford Site Wildfire

Sample Site Name	Sample Location^(a)	Collected Number of Days Early	Priority Tests^(c)
Prosser Barricade	31	1	Gross alpha, gross beta, gamma
Rattlesnake Springs	33	-1 ^(b)	Gross alpha, gross beta, gamma
Leslie Groves	37	6	Gross alpha, gross beta, gamma
Kennewick	39	7	Gross alpha, gross beta, gamma
Pasco	38	7	Gross beta, gamma
Byers Landing	28	7	Gross alpha, gross beta, gamma
Dogwood Met Tower	27	7	Gross alpha, gross beta, gamma
W End Fir Rd.	26	7	Gross alpha, gross beta, gamma
Battelle Complex	29	0	Gross alpha, gross beta, gamma
Benton City	40	0	Gross beta, gamma
Horn Rapids Substation	30	0	Gross alpha, gross beta, gamma
Yakima Barricade	32	0	Gross alpha, gross beta, gamma
300 NE	19	0	Gross alpha, gross beta, gamma
300 South Gate	16	0	Gross alpha, gross beta, gamma
300 Trench	18	0	Gross alpha, gross beta, gamma
300 Water Intake	15	0	Gross alpha, gross beta, gamma
300 South West	17	0	Gross alpha, gross beta, gamma

(a) See Figure 4.1.1.

(b) Collected late due to no access to the Fitzner/Eberhardt Arid Lands Ecology Reserve Unit.

(c) The air task routinely combines biweekly samples for nearby locations (or, in some cases, a single location) into quarterly composite samples (see Table 4.1.1). During the fire, some of the biweekly samples were analyzed individually for gamma-emitting radionuclides.

References

- 40 CFR 141. U.S. Environmental Protection Agency. "National Primary Drinking Water Regulations; Radionuclides; Proposed Rule." *Code of Federal Regulations*.
- EPA-570/9-76-003. 1976. *National Interim Primary Drinking Water Regulations*. Office of Water Supply, U.S. Environmental Protection Agency, Washington, D.C.
- PNNL-13487, APP. 1. 2001. *Hanford Site Environmental Surveillance Data Report for Calendar Year 2000*. L. E. Bisping, Pacific Northwest National Laboratory, Richland, Washington.
- WAC 173-201A. "Water Quality Standards for Surface Waters of the State of Washington." Washington Administrative Code, Olympia, Washington.
- WAC 246-290. "Group A Public Water Systems." Washington Administrative Code, Olympia, Washington.

